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TECHNOLOGICAL ASPECTS OF: (b) Conversion of military capacity

Scientific and Technological Aspects of the Conversion of Military Capacities for Civilian Use and Sustainable Development

An Overview of main issues

Report by the UNCTAD secretariat

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Executive summary

(i) Military production and expenditures continue to be a source of deep concern in a world in which the majority of countries face severe economic, social and financial problems reinforced by an increasing environmental degradation.

(ii) The end of the cold war and the evident decline of military threats between major powers of the world have raised hopes that political leaders will seize an historic opportunity to focus their attention on productive human endeavours which might be financed from redirecting some of the resources allocated to the military or could accrue from peaceful application of a vast scientific and technological reservoir formerly at the exclusive disposal of the military.

(iii) This situation underscores the need for conversion of military production and technologies as an effective strategy to accompany national and international disarmament efforts, and as a contribution to a development path in harmony with the natural carrying capacity of our planet.

(iv) The new paradigm of sustainable development has broadened the traditional understanding of security: threats to nations or to the world community are no longer limited to military aggression. Global environmental change and the destabilizing effects of the persistent poverty of large segments of the world population are equally perceived as vital risks to nations.

(v) The notion to diversify resources traditionally spent on the military and released in the process of disarmament to address such risks is intriguing. Scientific and technological aspects, including the conversion of military research and development (R&D) with the objective to develop environmentally sound technologies, or to find ways for halting environmental degradation in parts of the developing world, are of particular interest in this context. However, the existing potential of resources, skills and technologies is currently not used.

(vi) The report begins with an introduction of the concept of conversion and recalls United Nations activities related to its scientific and technological aspects. It continues by describing the role of science, technology and R&D in the conversion process. Furthermore, it illustrates how military R&D and technologies could be used for environmental protection in the pursuit of sustainable development. Finally, the report concludes with references to several issues of concern to the international community and to potential priority areas for further consideration in the above context.

Preamble

1. This study has been prepared pursuant to the Economic and Social Council Resolution 1993/70 which requested that a report be submitted to the Commission on Science and Technology for Development at its second session on scientific and technological aspects of the conversion of military capacity for civilian use and sustainable development.1/ The report was to draw on recent and ongoing activities in this field including the international conferences organized by, or in cooperation with, the United Nations Secretariat on scientific and technological issues of conversion. Particular reference was also made to the activities of UNCTAD and of the Ad Hoc Working Group on the Interrelationship between Investment and Technology Transfer (E/CN.16/1995.10).

2. Independently, the Trade and Development Board of UNCTAD, by decision 420 (XLI) of 30 September 1994 adopting the terms of reference for the Ad Hoc Working Group to Explore the Issue of Structural Adjustment for the Transition to Disarmament,2/ has referred to the relaxation of international tensions which provides incentives and opportunities for countries to reduce military spending and to divert such resources towards socially productive uses. The work of the Ad Hoc Working Group was to be coordinated with that of other committees of the United Nations. Accordingly, the findings of this report will also be made available to the working group.

3. The UNCTAD secretariat acknowledges the voluntary cooperation and the substantive inputs received from the Institute for Environmental Protection (INFU) of the University of Dortmund, Germany, in the preparation of this report.

Introduction

4. Throughout history there has always been some reduction in military production in times of détente following wars. However, the end of the Cold War, in the aftermath of one of the biggest military build-ups and arms races ever, has left in its wake problems of unexpected magnitude. For the first time, the need to transform large-scale scientific, technological and industrial capacities designed to serve the military-industrial complex has become a worldwide phenomenon affecting all major powers as well as many smaller countries. At the same time, the challenges of global environmental change as well as persistent poverty, particularly acute in developing countries, have led the world community to adopt - at the United Nations Conference on Environment and Development -a new paradigm of sustainable development. The question of how to redirect some of the resources formerly devoted to the arms race towards environmental protection and accelerating the development process has increasingly become part of this discussion. Such a "trade-off" has been termed the "peace dividend". It became evident, however, that the process of conversion is complex and that it encompasses a broad range of issues of concern to the international community. These include:

- **A new understanding of "security"**: Threats to nations are not simply just military threats. Today, the future of nations is equally threatened by global environmental change and economic or social instability;

- **Industrial restructuring for sustainable development**: Conversion of the military-industrial complex into clean, market- and consumer-oriented production facilities is part of overall efforts of industrial restructuring in the pursuit of sustainable development;

- **Human Resources Issues**: In countries where the military sector (industry, national R&D institutions, and the armed forces themselves) is particularly important as compared to overall economic activity, unemployment - including that of scientific and technological staff - resulting from disarmament, could lead to an outflow of skills to nations still expanding military R&D and production;

- **Cleaning of abandoned military sites**: These are often among the worst areas struck by toxic waste pollution. This is a task which requires scientific and technological inputs. Closely related to this aspect of conversion is the environmentally sound disposal of existing military hardware;

- **Developing timely alternative use plans for military sites and facilities**: This is part of the development strategy in communities heavily dependent on the presence of such facilities. It is essential to avoid large-scale unemployment and to secure public support for conversion measures. It requires, *inter alia*, technology assessment and economic projection.

5. Different terms are being used to describe the process of conversion. For example, the Department of Defense in the United States of America prefers the term "reinvestment", thus focusing on "the investment activities of the

Department of Defense that can lead to new opportunities in the economy and for business."3/ This includes "investment in people" who formerly served in the armed forces or worked for the defence industry by providing job-training programmes and information services for career changes, investment in technology as well as reinvestment of capital assets (such as closed bases, unneeded technical laboratories etc.).4/ Similarly, UNCTAD's Trade and Development Board has used the term "structural adjustment for the transition to disarmament", emphasizing the restructuring of economies. Throughout this report, the term "conversion" is being used to represent a broad array of measures which are economic, political, scientific and technological. Furthermore, the term "restructuring" is introduced where applicable.

6. The growing body of knowledge from actual conversion experiences (both successful and failed ones) in different parts of the world has been accompanied by a broad discussion of strategies to utilize the expected peace dividend for sustainable development efforts. Such a pay-off cannot simply be described in financial terms. While the release of actual financial resources from military to civilian budgets is questionable, the peace-dividend essentially exists in terms of human resources as disarmament is freeing scientific and technical personnel to pursue profitable civilian R&D, and in terms of a long-term economic impact resulting from the restructuring of production from a narrowly-based military one to a more efficient production serving a broader civilian market. It is in this context that a conversion policy to manage effectively the disarmament process is of utmost importance.

I. United Nations activities

7. Before entering into the general discussion, a brief account of United Nations activities related to scientific and technological issues of conversion is provided to serve as an overview of past activities.

8. The United Nations has long served as a forum to discuss military conversion activities. A study undertaken by the United Nations Institute for Disarmament Research (UNIDIR) recalls that successive United States and [former] USSR draft proposals in 1962 for a "Treaty on General and Complete Disarmament (GCD) provided for control and conversion of military R&D for peaceful civilian purposes."5/ The United States' "Outline for basic provisions on a treaty on GCD in a peaceful world" of 18 April 1962 called for the establishment of an international disarmament organization within the framework of the United Nations. Such an organization would collect reports from the "Parties to the Treaty" on any basic scientific discovery and any technical invention having potential military significance and - on the recommendation of expert study groups -work out agreed arrangements for verification by the organization that "such discoveries and inventions were not utilized for military purposes". Furthermore, "the Parties to the Treaty would agree to support full international cooperation in all fields of scientific research and development and to engage in full exchange of scientific and technical information and free interchange of views among scientific and technical personnel".6/

9. In spite of such early efforts, conversion did not become politically feasible until the late 1980s when a new détente in international relations changed such ideas from an utopian concept into a very practical problem to be

solved in many parts of the world. Again, the United Nations served as a forum for such discussions on conversion. Thus, in 1988, the United Nations University (UNU) was co-sponsor with Meiji Gakuin University of a conference on *Science and Technology for Peace: Towards Conversion of R&D from Military to Civil Use*, in Yokohama, Japan. This conference brought together peace researchers from several countries to discuss the new opportunities arising from a changing political climate in the world and possible shifts in the established system of alliances. Yet, the resulting prospects for converting military into civilian R&D were still more a theoretical than a practical matter.

10. In September 1989, the former United Nations Centre for Science and Technology for Development (UNCSTD) convened a panel of eminent persons in New York to reflect on a number of issues of global significance including "Disarmament and economic conversion". Starting with an account of the immense armament expenditures world-wide at the time, the experts called for a conscious conversion of military resources towards economic development.7/ Subsequent events underlined the relevance and the timeliness of this subject. Moreover, these events transformed the issue of conversion from the subject of an academic discussion into a compelling economic need in many countries.

11. In the 1990s, the linking of conversion to the struggle for sustainable development became an issue increasingly addressed at the United Nations. Thus, in 1991, the Secretary-General of the United Nations provided the General Assembly with a report on the issue of "General and complete disarmament", entitled "Charting potential uses of resources allocated to military activities for civilian endeavours to protect the environment."8/ The study proposed, *inter alia*, to utilize technological capabilities of military establishments including their R&D endeavours, laboratories, equipment and expertise for measures designed to protect the environment. It identified such opportunities, particularly with respect to dual-use technologies, areas such as environmental monitoring, environmental emergency management, impact assessment, and specific actions to protect the environment (for example, improved energy production and utilization, environmental clean-up, waste treatment and remediation strategies). Reflecting such discussions over the previous years, the Secretary-General's 1994 "Agenda for Development" called for world hearings on the connection between disarmament and development.9/

12. In addition, between 1991 and 1993, four major United Nations conferences were organized to address particularly scientific and technological issues of military conversion: The first of these, the *Conference on International Cooperation in Peaceful Uses of Military Industrial Technology* (Beijing, China, October 1991), was jointly organized by UNCSTD and the China Association for Peaceful Use of Military Industrial Technologies. It suggested that international cooperation include arms-related trade arrangements and regulations, and the transformation of existing bilateral programmes of military assistance into bilateral development programmes specifically designed to facilitate the transition to disarmament. Participants proposed that the United Nations assist in facilitating the transfer of know-how or cooperation between nations in diverse areas such as the destruction of chemical weapons, peaceful uses of outer space and the aerospace complex.10/

13. The international conference on *Conversion - Opportunities for Development and Environment* (Dortmund, Germany, February 1992) was jointly organized by UNCSTD and the Institute for Environmental Protection (INFU) of the University

of Dortmund, under the sponsorship of the State Government of North Rhine-Westphalia. It considered a broad set of issues related to military conversion ranging from sustainable development aspects to East-West and North-South cooperation. The conference explored, in particular, opportunities for development and environmental protection with special emphasis on the role of science and technology. These discussions resulted in the Dortmund Declaration, a portfolio of specific recommendations to the international community and national governments (see Box 1).11/

Box 1

Excerpts from the Dortmund Declaration

- Disarmament is an essential pre-condition to respond to increasing economic, social and financial needs and to reverse trends of environmental degradation at local, national and international levels. However, to implement disarmament efforts and to reduce the international proliferation of arms, it is indispensable to introduce policies and programmes of conversion of military production and technology for its civil use, preferably under the governance of the United Nations;

- Policies of military conversion should address environmental issues. Specific conversion activities should be based on technology assessment exercises, taking into account environmental concerns;

- The transformation of military-related research and science and technology activities has to be addressed as a central area of conversion policy;

- Scientific institutions should be supported worldwide in their efforts to give special attention to research on economic, technological, sociological, organizational and environmental aspects of conversion and to seek new forms of international research partnerships, in particular, in co-operating with institutions in developing countries and countries with economies in transition.

(Source: Conference report "Conversion- Opportunities for Environment and Development").

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14. The United Nations Conference on the *Conversion of the Aerospace Complex* (Moscow, Russia, October 1992) was organized by the former United Nations Department of Economic and Social Development (DESD) in cooperation with the Government of the Russian Federation. It analyzed the aerospace complex as a particularly promising area with regard to the conversion of scientific and technological capacities. Among its recommendations to the international community, policy-makers and the private sector was a proposal to establish national and regional conversion centres. Linked through data bases, these centres would provide institutional support to Member States and training for managers of military enterprises. One major follow-up activity of the Moscow Conference was the establishment of the Russian Centre for Conversion of the Aerospace Complex12/ (see Box 2).

Box 2:

Russian Centre for Aerospace Conversion

The Russian Centre of Aerospace Complex Conversion was created in accordance with a decree of the President of the Russian Federation. The Centre started its operational work in January 1993. It aims at promoting the conversion of the scientific, technical, industrial and personnel potential in the existing aerospace complex; at increasing the economic, social and ecological potential of cooperation in this field; promoting the conversion of military enterprises and their integration into the world economy; creating the necessary material and technical conditions, and providing legal support, coordination and information in order to carry out national and international programmes and projects. Among the members of the Centre are large corporations of the Russian aerospace complex as well as other branches of industries, leading design bureaux, scientific centres, banks and other commercial and public institutions. The Centre establishes mutually beneficial relations with Russian enterprises and organizations, foreign investors and partners, and supports the creation of financial and industrial companies, production and economic associations, banks and all other necessary structures. It creates also branches and representations in Russia and abroad. The Centre elaborates and monitors regional and international programmes and projects. It cooperates with international organizations such as the United Nations Secretariat, UNIDO, UNDP, national and regional aerospace agencies as well as different foreign partners. The main fields of cooperation are in advanced material technologies in aviation, cosmic, radio - electronic, communication and other industries.

(Source: Russian Centre of Aerospace Complex Conversion).

15. The conference on *International Cooperation to promote Conversion from Military to Civilian Industry"* (Hong Kong, July 1993) was jointly organized by the United Nations Department for Development Support and Management Services (DDSMS) and the China Association for Peaceful Use of Military and Industrial Technology. The *Hong Kong Declaration on Conversion from Military to Civilian Industry* emphasized, in particular, the need for international cooperation, new funding strategies, training and information. It highlighted the importance of creating enabling environments for military enterprises to carry out conversion. In this context, it also stressed the particular need to focus on human capital in the military industry as an invaluable source in the conversion process.13/

16. In addition to the above, a number of United Nations bodies have addressed issues of conversion within their specific mandates. These included, *inter alia*, the Global Technology Group of the United Nations Development Programme (UNDP),14/ the International Labour Office (ILO)15/, the United Nations Economic Commission for Europe (ECE),16/ the United Nations Environment Programme (UNEP),17/ the United Nations Institute for Disarmament Research (UNIDIR)18/ the United Nations Industrial Development Organization (UNIDO),19/ and the United Nations University (UNU).20/

II. Scientific and technological aspects

A. The role of science and technology and the military

17. In today's economies, science and technology are dynamic forces and important factors in the prospects for development, growth and social welfare in developed and developing countries alike. Science and technology can be both highly creative forces, driving economic productivity and contributing to a broad range of societal goals, such as improved food production, public health and human development, as well as destructive ones causing pollution, environmental degradation and the development of lethal weapon systems. A UNIDIR study concluded: "In fact, the employment of science and technology for military purposes and the accumulation of weapons of mass destruction amounts to a perversion of science. It contradicts the basic calling of science and technology - which is the betterment of the human condition."21/

18. The relationship between the scientific community and the military intensified in the years following the Second World War, a period in which the military apparatus has "been grounded increasingly on the application of advanced scientific knowledge to weapons of mass destruction." 22/ Indeed, many countries regarded military research and development as an important element of national security.

19. According to a study conducted in the late 1970s, 24 per cent of the global R&D efforts were military driven compared with, for example, 8 per cent allocated to space, 8 per cent to energy, 7 per cent to health, 5 per cent to transportation, and 3 per cent to agriculture and food production.23/ The 1994 *Human Development Report* estimated the number of people engaged in military R&D at 1.5 million (out of 5-7 million of total R&D personnel worldwide).24/ Thus, military R&D could be considered a major employer of scientific and technical personnel. In many countries, military R&D even reached a dominant position

within the national R&D infrastructure, at least temporarily. Altogether, since World War II, hundreds of billions of dollars have been spent on military R&D.25/ Since, in most cases, the actual spin-offs of military technology have been few and as the secrecy surrounding military R&D has prevented timely reflection of a systematic utilization of its results in civilian applications, R&D funding of key civilian technologies which could contribute to development have been severely constrained. The reduction of military expenditure should thus be expected to liberate significant scientific and technological potential for civilian use.

20. In the above context, a working paper submitted by Colombia to the United Nations Disarmament Commission referred to the enormous technological inputs still required for the process of development and the continuing asymmetry which exists between the technological capacities of the developed and the developing countries.26/ The paper concluded that, in light of such discrepancies, military research reflected a wastage of manpower, skills, talent and economic resources which, in the long run, could contribute little to the economic development of nations.

B. Conversion of R&D resources

21. Military R&D has been a central element of the arms race. Yet, the restructuring of public and private military R&D sectors and their possible conversion to civilian purposes is not an easy endeavour and the scope for action may be limited. The myth that military R&D intrinsically contains large spin-offs of considerable economic utility only holds true for a limited number of technologies, known as dual-use technologies in areas such as computer sciences, avionics, semi-conductor devices and electronics. According to UNIDIR, in some areas the opposite interaction has taken place, i.e. civilian technologies have had military "spin-ons", rather than military R&D benefiting civilian production in the long-run.27/ Similarly, the Office of Technology Assessment of the United States Congress has found that "increasingly, leading - edge technology is developed in the civilian sector and then finds its way into defense applications."28/

22. In view of the above, a diversified conversion strategy is required relying on identifying specific technologies, developing clear targets and setting priorities. A study prepared for the United Nations University (UNU) came to the conclusion that there are basically four options for military R&D facilities, each with different consequences: (a) continued funding with the aim of gradually diversifying into non-military R&D. The concern, however, would be that these facilities could again revert to military work; (b) giving military R&D facilities entirely civilian tasks (complete conversion); (c) disbanding the facilities irrespective of the employment and other economic effects involved; and, (d) mothballing facilities and maintaining skeleton staffs that continue to have as their primary mission the development of new weapons.29/

23. The establishment of an effective strategy in response to the above choices involves several stages. As a first step, levels of public and private R&D expenditures on military as compared to civil use could be documented and the benefits analyzed. As a further step, diffusion of knowledge from military to civilian entities in R&D as well as production could be encouraged through

appropriate incentive schemes and legislation. In this context, operational programmes dealing with a changing role for R&D institutions need to be developed in accordance with the overall restructuring of military hardware usage, military facilities, personnel training, etc., as well as action related to environmental recovery.

24. A number of initiatives for R&D conversion which have been taken in various countries illustrates the range of opportunities. The Government of the United States, together with the "Big Three" automobile giants, General Motors, Ford and Chrysler, announced in October 1993 a common research project to develop a "vehicle for tomorrow". The project aims in particular at reducing the fuel consumption of automobiles to one-third of today's consumption over the next ten years. The United States Government intends to involve mainly scientists and research laboratories formerly occupied by military and defence-related research activities. The project should determine how new advanced materials, originally developed for military applications, could be used in car manufacturing. It should focus on the use of new electrical engines which were developed under the Strategic Defence Initiative (SDI) in cars and should give emphasis to three main areas: first, new production technologies to expedite the development of automatic systems; second, the improved efficiency of automobiles in terms of lower environmental pollution, and, third, the development of new prototypes that consume only 30 per cent of current fuel use. The cost of the project will be shared between the United States Government and the automobile industry. While the Government will not grant direct financial means for the project, it will provide research capacities of governmental laboratories that would otherwise close because of a reduction in the defence budget. The project was compared with the "Man to the Moon" programme under the Kennedy Administration, because it is expected to identify and produce spin-off technologies for other sectors.30/

25. Likewise, in the United States, a political initiative was proposed by the former Governor of the State of New York, Mario Cuomo, to connect the state capital, Albany, with New York City by a magnetic-levitation high speed train system. This proposal was made in November 1993 with the specific purpose of involving the New York defence industry in the project. Mag-lev-trains are perceived as an environmentally safe and future-oriented means of transport that allows especially highly sophisticated defence industries to open up a new civilian global market.31/

26. A Russian space technology company, "Sojuz", has developed a technology which made it possible to produce diamonds from explosives used in shells and ammunition. The technology became the basis for a joint venture with a German company and became particularly important for the decommissioning and denaturalization of military ammunition such as shells. Up to then, explosive substances had to be incinerated, causing severe environmental problems at very high costs. With the newly produced diamonds, it was possible to find a profitable way to recycle harmful chemical substances.32/

27. The above examples give evidence of the diverse opportunities for restructuring military R&D into economically and environmentally useful production. Over the past decade, there have been many more experiences, particularly in the Russian Federation and in the People's Republic of China. According to the Russian experience, enterprises oriented to production in fields of medium-level technology were often able to find new customers on

domestic markets, while high-tech R&D facilities which had never been incorporated into the overall structure of industry encountered substantial difficulties.33/

28. Since conversion is an integral part of overall industrial restructuring of economies, as referred to above, the incentive schemes that have been established to enhance the diffusion of science and technology more generally, could also be used as a framework for the conversion of military R&D and technology into civilian applications. These are described in detail in other documents made available to the Commission.34/ Such schemes have to pay attention to intellectual property rights which not only have important functions in the protection of technologies emanating from the military R&D activities, but also in licensing specific military technology for civilian use. The experience available to date has shown that intellectual property rights could be an important factor in the process of conversion. This role would need to be further examined in terms of different categories such as patents, utility models and copyrights.

29. At the international level, a number of options are available to redirect or transfer military R&D to civilian purposes. For example, technologies developed for decommissioning and demobilization of military hardware and ammunition could be made widely accessible at concessionary terms to interested countries through an international technology transfer mechanism whose feasibility needs to be explored. Furthermore, the data obtained by global monitoring satellites currently used exclusively for military purposes could be utilized for civilian R&D, especially for sharing global data among countries for resource development.

30. Initiatives for conversion of R&D resources are not limited to governments. The role of universities and scientific research centres is important in this context. Thus, bearing such responsibility in mind, the senate of the University of Dortmund (Germany) adopted the commitment "to conduct exclusively research activities that serve only civilian purposes and, furthermore, to ensure that in the future no R&D projects will be conducted which should serve discernibly military purposes". This self-commitment holds true as well for research projects carried out on a contract-basis.35/ Similar initiatives were taken by universities in the United States in the 1970s and 1980s.36/

C. Converting military into environmental technologies

31. One area where a conversion strategy is particularly useful concerns efforts to achieve sustainable development. Of all military capacities, "technologies qualify most for environmental use",37/ especially those which are inherently dual-use. Major areas in this regard include information technologies, materials, aerospace, space and energy. In this context, the reallocation of skills and capabilities from military to environmental tasks is needed, particularly in areas such as environmental monitoring, chemical analysis, cartography, medicine, microbiology and radiology. The transfer of such scientific and technological capacities at the disposal of the military to environmental applications encompasses several dimensions, particularly, (a) the need to redesign technologies to be suited to new applications; (b) the physical

transfer to locations where the technologies are needed (including other countries); and (c) cooperation between the government-directed military and the private sector in the commercialization of technologies.

32. The opportunities for conversion are seen both from the point of view of better and more efficient use of scientific and technological capacities of the military for the development of environmentally sound technologies, on the one hand, and repairing the current environmental damage, including that caused by previous military activities on the other hand.

33. Modern military establishments "have developed highly sophisticated techniques and technologies such as sensors, platforms, satellites, computers, communication networks, global positioning systems, and exercises for simulation and modelling".38/ In some instances, environmental applications have either already been undertaken or are under way. In others, the underlying technology can be adapted. Information technology, in particular, seems to be adaptable for environmental purposes. Resources currently used by the military could be applied to protect, restore and improve the environment; military establishments can assist in achieving these objectives by contributing their technical expertise, advanced equipment and communications and surveillance systems. The range of scientific and technological areas which could be used for such purposes include: (a) the industrial and technological capacity within the areas of transportation, communication, energy and engineering, including the development of ecologically benign and energy efficient technologies; (b) linkages between existing networks of the military sector, universities and other institutions for the dissemination of information and data, including measures for raising environmental consciousness; (c) satellite technologies for remote-sensing, global monitoring and telecommunication; (d) technical capacity in laboratories and computer facilities to detect and combat environmental degradation; (e) military manpower and equipment for disaster relief, including responses to environmental catastrophes, and handling or disposal of highly toxic, radioactive and other harmful substances as well as the destruction of weapons.39/

34. The defence community has at its disposal a wealth of information gathered by intelligence sources that can assist in tracking changes in the atmosphere, the oceans and the surface of the earth. Military satellites, aircraft, surface ships and submarines have the ability to collect additional information about climatic changes and the flow and temperatures of oceans (see Box 3). In this context, techniques for military surveillance could be employed for monitoring transportation of pollutants and toxic materials, and for ensuring compliance with ecologically safe methods of weapons disposal.

Box 3:

"Military data for research on the environment"

Since November 1992 all available data of the "Integrated undersea sound surveillance system" of the US-Marine are being used for a project called "Whales 93". This civilian research project uses hydrophones that have been developed and deployed originally by the US-Marine to monitor and survey [former] Soviet submarines on their missions in the world oceans. Already, within the first three months, it was possible to register 35000 sounds and data derived from undersea earthquakes, volcanoes and whales. Whales generate for their navigation and search for food, sounds on low-frequency waves that can be heard over long distances and that can be distinguished through the use of hydrophones. One of these sea-mammals was tracked continuously for 43 days. The scientists involved in the project are seeking to find out the trails of the whales through the oceans and regional differences in their singing. The hydrophone system reaches almost completely across the Atlantic and Pacific Oceans. Scientists can use this military monitoring system, but are not allowed to make public the exact locations of the hydrophones and their performance capacity.

(Source: Frankfurter Allgemeine Zeitung, 1 September 1993).

D. Cleaning-up the Cold War legacy

35. Military activities have caused such formidable damage to the environment and to human health that their consequences will be felt for decades and, in instances of forms of radioactive contamination, for much longer. Unfortunately, hardly any of the world's nations are devoid of contaminated military sites, devastated landscapes, polluted groundwater and injured biota; furthermore, damage has been spread throughout the oceans and atmosphere. In those developing countries which have emerged from long periods of war or other conflicts, land-mines contaminate fields and roads.

36. The catastrophic nature of environmental contamination becomes more apparent as additional sites of contamination are discovered and as the effects of the damage at known sites manifests itself fully. The seepage of chemical or radioactive contamination into water systems and the corrosion of containers dumped at sea, containing chemical weapons or radioactive material are but two examples of problems that grow more serious with the passage of time. This will be discussed below (see also Box 4).

Box 4

A new horizon for Subic Bay

"The U.S. Naval facility at Subic Bay in the Philippines was one of the world's largest overseas military bases. Its transformation illustrates some of the major problems and opportunities of converting bases from military to civilian use.

(....)

By the time the base closed in 1992, the mayor of Olongapo had helped establish a Subic Bay Metropolitan Authority whose aim was to turn the former base into the "Hong Kong" of the Philippines. At the end of 1993, the authority had attracted 33 investors and US$ 340 million to the base including a US power corporation now running the power plant, a US petroleum company using the fuel tanks for distribution, Philippine garment manufacturers and international investors interested in creating resort facilities.

But the unknown level of environmental contamination - probably the most significant obstacle to further progress - is already deterring some international investors and could pose serious health problems in the future."

(Source: UNDP - Human Development Report 1994)

37. The scope of the problem and the technological needs can only be hinted at. Thus, pollution from radioactive waste stored on land and at sea is a subject of great concern. In some regions, nuclear waste has been stored in disregard of internationally accepted standards established to prevent environmental damage. Locating and assessing such sites is particularly urgent. In the first place, efforts must focus on pollution from radioactive materials, primarily those affecting oceans and waterways and, secondly, on chemical pollution resulting from the dumping of chemical weapons. In this context, problems of radioactive contamination arising from the accidental loss and decommissioning of nuclear submarines have received considerable public attention in the recent past. It is necessary to assess the effects on the marine and human environment of present levels of radioactivity, including the risks of increased levels of contamination owing to corrosion.

38. Similar problems exist regarding the storage and dumping of chemical weapons. The first step needed is to assess the contamination status and to identify the different chemical agents that are involved. The next step would be a risk analysis that takes into consideration the evaluation of corrosion, leakage and dispersion processes and the possibility of local migration and bio-accumulation. Priorities must be established and accurate estimates must be made of the remediation costs.

39. Another most pressing issue involves the introduction of remedial technologies for the treatment of contaminated land and groundwater. Such remedial technologies have to encompass biological, chemical, physical and thermal waste treatment technologies. The conversion and disposal of explosives and propellants are important tasks for future activities in this area. However, the applicability of recycling technologies as well as chemical disposal technologies for conversion purposes is still limited. Further investigations are currently underway in order to develop new processes and to improve the product quality. For example, experimental studies have demonstrated the biotechnological degradability of a series of explosives. Microbiological treatments make use of natural purification effects working with water streams under high pressure and using chemical additives. Such new technologies open up completely new horizons to the elimination of dangerous materials (see also Box 5).

Box 5

"**Chemical weapons technology to combat natural disasters**".

One of the most secret military research institutions of the Russian Armed Forces was recently partly opened to the public to allow civilian research activities. Under the overall guidance of the Ministry of Defence of the Russian Federation, a new Department of Ecology and Special Means of Defence was established that uses mainly research capacities which were formerly devoted to the development of chemical weapons. It is selling new civilian technologies on the international market. One missile technology was, for instance, transformed to fight huge industrial fires such as those at oil wells during the Gulf War. This technology uses special missiles to combat fires from a distance without endangering the firefighters. Another technology was developed to fight against desertification in the Aral Sea. This technology uses a liquid polymer that can be sprayed over large-scale regions. After a short while, it binds the soil and sand and allows the flora to resettle in this region. This technology can be of particular use to combat desertification in semi-arid areas of the world.

(Source: Presentation by Gen. Sergei I. Grigorov at the International Workshop on Remediation of Contaminated Military Sites, Berlin, September 1993).

40. The effort needed to correct these problems is truly massive. A comprehensive and fast solution is beyond the economic means of today's societies. Even spread over generations, satisfactory clean-up can only be managed by prioritizing the problems, tackling or containing those that are the most urgent and developing more cost-effective technologies. International efforts are imperative, not only because of the magnitude of the problem, but

also because of their transboundary character. This requires a coordinated effort relying heavily on existing institutions, including military ones, to share experiences and resources. Such cooperation would be a first vital step towards eliminating the most noxious and long-lasting consequences of the Cold War. Some such initiatives are already under way. Thus, for example, work plans as well as pilot studies proposed by the Science Committee of the North Atlantic Treaty Organization (NATO) and its Committee on the Challenges of Modern Society (CCMS), have started to enable cross-national cooperation and consultation in political, military, economic, scientific and environmental domains and have greatly intensified NATO's involvement in environmentally-related issues.40/ Those initiatives have involved non-NATO Member States such as the economies in transition.

III. Conversion and sustainable development: Conclusions and recommendations

41. Serious efforts are necessary around the world to carry out and to promote the conversion process by specifically addressing the imperatives of socioeconomic development and environmental protection. The emergence of a high-level political will is a precondition for a successful conversion process and the materialization of a "peace dividend", even though existing economic imperatives and environmental forces could hasten this process.

42. Conversion could be viewed as a simultaneous and integral part of arms reduction efforts. In this context, its employment creation potential has to be weighed against the anxiety of potential unemployment owing to arms reduction and spending cuts in defence budgets. Similarly, the long-term export potential for civilian goods and services created by conversion should be balanced against the economic returns of the arms trade. There is no shortage of alternative uses of science and technology in areas such as alleviation of poverty, increasing demands for health, education and housing and pressing needs to protect and improve the environment.41/

43. Conversion is an exercise where tremendous short-term costs have to be balanced against long-term benefits and opportunities. Cleaning up the Cold War legacy and restructuring industry are complex and costly ventures. At the same time, science and technology have become ever more important elements of countries' international competitiveness, and funds spent on military R&D - and therefore not available to civilian R&D today - may have long-term adverse economic effects.42/ Thus, the restructuring of military R&D establishments should be viewed as an investment process that allows more funds to be channelled into key technological areas rather than into the development of weapons.

44. Conditions for conversion differ between industrialized countries, developing countries and economies in transition. In each context, it is necessary to identify a portfolio of basic human and ecological needs to which conversion measures could be directed and to identify the scientific and technological resources that can meet such demands. The issues outlined below could provide a framework for future action by both the international community and national governments.

A. Using the potential of dual-use technologies

45. There are no "good" or "bad" technologies. The difference between the former and the latter depends on their application. This can be seen in the context of the so-called "dual-use-technologies" which may be applied both for military and civilian purposes. Dual-use technologies relate to the assumption that, for some military technologies, important spin-offs to civilian uses do exist. Such technologies are most likely to be "converted" if useful and commercial applications can be found. The exact potential of dual-use technologies currently applied by the military needs to be explored.

46. The notion of using technologies developed by military R&D to, for example, finding clean and efficient energy production, ways and means to combat desertification, or for profitable space exploration, is particularly intriguing. This report has identified some areas for applying existing military technologies in cleaning up ecological damage. The spectrum of technologies to be explored for their conversion potential includes, for example, information technology, materials, biotechnology and energy. The spectrum of alternative applications ranges from environmental monitoring to cleaning up toxic waste. The full potential of dual-use technology is currently not used and should be given sufficient consideration (see Box 6).

B. Linking conversion initiatives to the needs of developing countries

47. In the discussion of conversion measures, the situation and the needs of developing countries have often not been sufficiently addressed. These include three very different dimensions. First, many developing countries themselves have participated in the arms race in a way that is no longer affordable. Second, some of the most urgent environmental problems are to be found in the developing world, creating a demand for new and efficient environmental technologies. Third, developing countries have had high - but so far unfulfilled - hopes that part of the savings from military spending in the industrial countries would be diverted to accelerate the development process. In this context, the following tasks might be given further consideration: (a) in most developing countries, particular emphasis would have to be given to the retraining of former military personnel and environmentally sound disposal of military hardware; (b) in those countries which have experienced periods of war and conflict, specific measures, such as the removal of land mines, remain unresolved problems which need to be addressed; (c) in developing countries which have a substantial military industrial base themselves, including R&D facilities, alternative ways of promoting high technology in converted or new industries have to be developed;43/ in such cases, conversion needs are often similar to those of the industrialized countries and the economies in transition; (d) particular attention could also be given to technologies likely to stop environmental degradation and desertification and help to clean up existing environmental damage. As regards the latter, the relaxation of security needs with regard to

Box 6

Selected areas of dual-use technology and production processes.

- Ferrous and non-ferrous metallurgy, cintering and bonding;
- Power engineering, electrical engineering, power plant engineering, electrical machine engineering, electric welding;
- Atomic power, atomic energy, nuclear safety, nuclear materials;
- Coal, gas and petroleum engineering;
- Ship building, ship and boat maintenance and retrofitting;
- Heavy and transport engineering, railway and marine transport;
- Chemistry, petrochemistry, chemical machine building;
- Light industry machine building;
- Food, conservation and packaging;
- Special textiles, garment, footwear including manufacturing of exercise and sport goods;
- Agriculture, aquaculture, undersea and sea-bottom engineering (and sciences);
- Aircraft;
- Telecommunications, radio, television;
- Instruments and tool-making design and engineering;
- Optical instrument making, electro-optics engineering;
- New materials;
- Space technology, satellites, related training;
- Engineering potential for alternative product designs in presently unutilized market niches.

(*Source: Paper by Joseph Ben-Dak, UNDP, see endnote 14*)

the diffusion of technologies formerly reserved for military purposes could enhance developing countries' efforts to acquire new technologies that would facilitate the path towards sustainable development. As in the case of environmentally sound technologies, new forms of research partnerships and technology cooperation are needed to address the questions raised above. These will have to include measures to protect intellectual property rights, on the one hand, and to provide developing countries with opportunities to have access to such technologies, on the other hand.

C. Increasing international cooperation

48. As conversion of both military R&D and production is a complex process, often exceeding the capabilities of individual nations, cooperation between countries, strategic alliances between companies at a pre-competitive level, and scientific and technological networks and information exchanges, are an imperative for successful conversion by sharing costs and boosting investments in civilian high technology. Access to technologies is an important issue in this context.

49. Possible activities at the international level to accelerate the process of conversion from military R&D and production to civilian R&D and production could include measures such as: (a) carrying out in-depth studies of environmental technology needs, on the one hand, and existing military R&D and

technologies capable for conversion, on the other hand; (b) assisting countries in defining the political, economic and legal conditions for conversion of scientific and technological capabilities established for military R&D and production; this would include addressing such issues as specific market demands, intellectual property rights and legal arrangements; (c) developing re-training programmes for scientists and engineers from R&D institutes and defence industries, particularly for countries threatened by a "brain-drain" of highly qualified scientific and technical personnel; (d) developing a portfolio of options and a compendium of pilot-projects for directing traditional defence spending to areas such as disaster relief, remote sensing for global environmental programmes, environmentally sound technologies, new and renewable sources of energy, waste management and recycling; and (e) assisting countries to set new priorities in science and technology at the national level with the objective of replacing extensive military R&D with civilian R&D. In this context, consideration could be given to undertaking technology assessments in order to identify adequate military R&D and technologies to be diverted to civilian applications. The international network, Conversion for Sustainable Development (ConverNet) represents an example of such an activity (see Box 7).

Box 7:

ConverNet - An International Network on Conversion for Sustainable Development

The United Nations Conference on "Conversion - Opportunities for Development and Environment", expressed the intention to establish an Information Exchange Network in order to respond to the need for a coordinated international conversion effort. The idea to create a global network for the international efforts on conversion, including the scientific community, was reinforced and elaborated during the United Nations Conferences in Moscow and Hong Kong. The Institute for Environmental Protection (INFU) of the University of Dortmund, Germany, is in the process of developing this communication medium for individuals and organizations. ConverNet is a computer network using the Internet intended to disseminate and exchange information related to conversion and to interchange thoughts, ideas and results that give an impetus to new research fields, topics, or technical projects. ConverNet supports the conversion community by providing tools for easy and quick access to exchange data and information. In the long-run ConverNet intends to provide an international mechanism for monitoring the transfer of know-how and technology in order to maintain an adequate flow of conversion-related technologies to developing countries.

(Source: Dortmund University).

50. In the above context, attention could be drawn to the proposal of the former Costa Rican President and Peace Nobel Laureate, Oscar Arias, to divert a small percentage of funds saved through decreased military expenditures to reward disarmament efforts in - primarily, but not exclusively - developing countries.44/ The Commission might consider any follow-up to this initiative and contribute to such an endeavour by proposing schemes for the conversion of military R&D and by identifying specific areas in which the needs of developing countries should be addressed.

IV. Final remarks

51. The restructuring of the military R&D apparatus is one among other measures to be taken up by the international community and national governments, in order to embark on a sustainable development path. Successful conversion schemes require international cooperation, taking into account the different conditions of individual nations. This cooperation might initially take the forms of workshops and seminars aimed at educating participants on the issues, costs and benefits of conversion. Linking the needs of developing countries to such schemes is an important task for ensuring sustainable development. While dual-use technologies seem to be particularly promising, it is still necessary to identify specific areas for in-depth exploration and to set concrete targets and priorities. Launching a conversion strategy means embarking on a long-term endeavour that goes hand-in-hand with the gradual process of disarmament throughout the world. In this respect, peace, of course, is in itself a dividend important enough to justify disarmament and conversion. Science and technology are significant forces in this process.

Notes

1/ See also: *United Nations Economic and Social Council: Report of the Commission on Science and Technology for Development* on its first session, (E/CN.16/1993/12), 28 May 1993.

2/ *Report of the Trade and Development Board on the first part of its forty-first session*, Geneva, 19-30 September 1994, vol. I (TD/B/41(1)/14), 14 October 1994.

3/ John M. Deutch, Under-secretary of Defense for Acquisition and Technology, Department of Defense, United States of America, in an interview with *Technology Review*, April 1994.

4/ *Ibid*.

5/ United Nations Institute for Disarmament Research: "Science and Technology between Civilian and Military Research and Development", Research Paper No. 7, (UNIDIR 90/97), New York, 1990, p. 20.

6/ *Ibid*. p. 20-21. The original text is to be found in: *Documents on Disarmament 1962, vol. 1*, Washington D.C., 1963, p. 379 (United States Arms Control and Disarmament Agency).

7/ United Nations Centre for Science and Technology for Development, Friedrich-Ebert-Foundation. Draft report on the Panel of Eminent Persons: *Disarmament/Conversion, Climate and Information Technology*, New York, September 1989, p. 1.

8/ United Nations, *Report of the Secretary-General on General and Complete Disarmament: Charting potential uses of resources allocated to military activities for civilian endeavours to protect the environment*, (A/46/364), 17 September 1991.

9/ United Nations, Report of the Secretary-General: *An Agenda for Development: Recommendations*, (A/49/665), 11 November 1994.

10/ For more details see: United Nations Centre for Science and Technology for Development, UPDATE no. 58/Winter 1991/92.

11/ United Nations Centre for Science and Technology for Development, Conference Report, International Conference on *Conversion Opportunities for Development and Environment*, Dortmund, 24-27 February 1992.

12/ United Nations Department of Economic and Social Development *Report of the United Nations Conference on Conversion of the Aerospace Complex - Technology Assessment for Development*, Moscow, 12 - 17 October 1992, New York 1993, (ST/STD/ATAS/Supp. 1).

13/ United Nations Department for Development Support and Management Services: Draft Report, 1993 Hong Kong Conference on *International Cooperation to Promote Conversion from Military to Civilian Industry*, Hong Kong, 7 - 11 July 1993.

14/ See for example, United Nations Development Programme: *The Global Technology Group. Draft, New York, November 1994. See also: Joseph Ben-Dak: Conversion of Military Industries to Civilian Markets and Expectations: A concept for a UNDP contribution.* Draft, 20 April 1992.

15/ The International Labour Office published an extensive series of working papers on the employment dimension of military conversion.

16/ See, for example, United Nations Economic and Social Council, Economic Commission for Europe, Committee on Energy, Steering Committee of the Energy Efficiency 2000 Project - Ad Hoc Meeting on the Conversion of Military Facilities and Manufacturing to the Production of Energy Efficient Technology, Ceska Lipa, 29-31 March 1994. (Energy/AC.11/18), 19 April 1994.

17/ While not currently involved in conversion, the United Nations Environment Programme co-sponsored a programme on "Environmental security" in the early 1990s which also addressed the "*Conversion of Military R&D*". Furthermore, UNEP analyzed the ecological impact of war.

18/ See particularly, United Nations Institute for Disarmament Research (1990), and UNIDIR: *Disarmament, Environment and Development, and their Relevance to the Least Developed Countries*, New York 1991, (UNIDIR/91/83).

19/ The United Nations Industrial Development Organization developed, *inter alia*, a programme for realizing the benefits of new technology spin-offs in developing countries in the light of a relaxation of security restrictions on the diffusion of high technologies from the defence sector.

20/ See, for example, papers presented at the United Nations University Conference on "*Arms reduction and economic development in the post Cold War era*", Tokyo, 4-6 November 1992, to be found in: Lawrence R. Klein, Fu-chen Lo, and Warwick J. Mckibbin: "*Arms Reduction: Economic Implications in the Post-Cold War Era*", Tokyo 1995 (United Nations University Press).

21/ United Nations Institute for Disarmament Research (1990), p. 1.

22/ David Dickson: *The New Politics of Science*, New York 1984 (Pantheon), p. 107.

23/ Colin Norman: "Knowledge and Power: The Global Research and Development Budget", *Worldwatch Paper 31*, Washington D.C. 1979, quoted from Dickson (1984), p. 110.

24/ United Nations Development Programme: *Human Development Report 1994*. New York, 1994, p. 47.

25/ Michael Renner: "*Cleaning up after the Arms Race*" in: *State of the World 1994*, New York, London 1994 (Worldwatch Institute), p. 138. Exact data on the percentage of military R&D out of total R&D expenditures are difficult to obtain from many countries. The OECD estimates this ratio at 5.9 per cent for Japan, 6.5 per cent for Italy, 10.5 per cent for Germany, 24.3 per cent for Sweden, 37.4 per cent for France, 45.1 per cent for the United Kingdom and 58.6 per cent for the United States of America. See: OECD *Main Science and Technology Indicators 1993*, Paris 1994.

26/ United Nations Disarmament Commission, substantive session, New York, 22 April - 13 May 1991, Agenda item 7, *The Role of Science and Technology in the Context of International Security, Disarmament and Other Related Fields*. Working Paper submitted by Colombia, (A/CN.10/156), 30 April 1991.

27/ United Nations Institute for Disarmament Research (1990), p. 17.

28/ United States Congress, Office of Technology Assessment: *"Holding the Edge: Maintaining the Defense Technology Base", OTA-ISC-420*, Washington, D.C. 1989. Quoted from UNIDIR (1990), p. 17.

29/ Herbert Wulf: "*The Dimensions of Conversion*", paper presented at the second meeting of the United Nations University Advisory Team on *Peace and Global Governance*, Barcelona, 24-25 October 1994, p. 9.

30/ S. Frankfurter Allgemeine Zeitung, 1 October 1993.

31/ S. Frankfurter Allgemeine Zeitung, 15 November 1993.

32/ S. Frankfurter Allgemeine Zeitung, 1 July 1994.

33/ Detailed data on China and Russia to be found in Michael Renner, *"Swords into Plowshares: Converting to a Peace Economy", Worldwatch Paper No. 96*, Washington D.C., June 1990 and in: Michael Renner, *"Economic Adjustment after the Cold War"*, Aldershot 1992 (a UNIDIR publication).

34/ See report of the Ad Hoc Working Group on the Interrelationship between Investment and Technology Transfer (E/CN.16/1995/10) and the report of the Panel of Experts on the Contribution of Technologies including New and Emerging Technologies to the Industrialization of Developing Countries (E/CN.16/1995/8).

35/ University of Dortmund, internal memorandum by the Rector on the issue of military research, 15 March 1991 (translation from German text).

36/ Dickson (1984), p. 110.

37/ United Nations, A/46/364 (*op. cit*), p. 47.

38/ *Ibid*., p. 30.

39/ Compare the detailed proposals in United Nations document A/46/364 of 17 September 1991, *op. cit*.

40/ J. M. Cadiou: "*Clean-up of the cold war legacy*", presentation at the International Workshop on Remediation of Contaminated Military Sites in Berlin, 20-22 September 1993. See also *NATO Newsletter*, issue No. 42, 4th quarter 1994.

41/ United Nations Institute for Disarmament Research: "*Economic Aspects of Disarmament: Disarmament as an Investment Process*", New York 1993, (UNIDIR/92/94), p. 5. Ample evidence of such needs also appears in the report of the Panel on Technologies for Small-Scale Economic Activities to Address the Basic Needs of Low-Income Populations (E/CN.16/1995/2) and the report of the Panel on Science and Technology Aspects of the Sectoral Issue to be discussed by the Commission on Sustainable Development (E/CN.16/1995/4).

42/ C.f. United Nations Institute for Disarmament Research (1993), p. 29.

43/ *Ibid*. p. 63-64.

44/ For details of the proposal, see United Nations Development Programme (1994), p. 59.